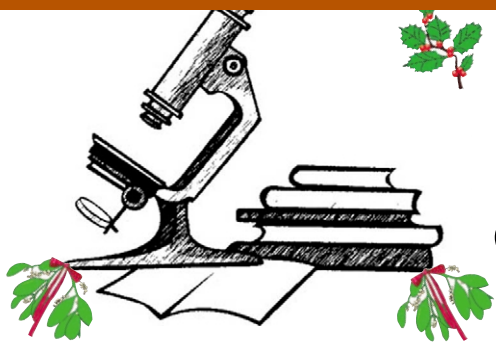
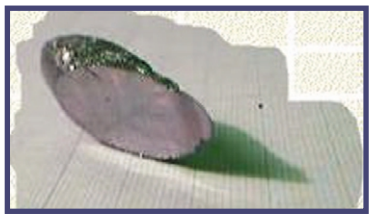


Research, reviews & patents

Nanowire its own solution

Large-scale fabrication of single-crystal selenium nanowires by the solution-mediated treatment of polycrystalline selenium powder is reported. The powder, along with NaOH and HPLC-grade water, were placed in an autoclave, stirred and heated to 150 °C for 24 hours and then cooled to an ambient temperature over the course of 3 hours. Product obtained by this hydrothermal process has been characterised by scanning electron microscopy and high-resolution transmission electron microscopy as well as X-ray diffraction techniques. The resulting selenium single-crystal nanowires are found to form from the dissolution-recrystallization mechanism. *Rapid, high yield, solution-mediated transformation of polycrystalline selenium powder into single-crystal nanowires.* Bin Cheng & Edward T. Samulski in *Chem. Communication*, (16), 2024-2025 (2003).



GaSe crystal
Picture courtesy: www.issp.ac.ru/lpcbc/ DANDP/GaSe.jpg

[Currently among application fields for Gallium Selenide (GaSe and GaSe:In) are second harmonic generation CO_2-lasers; the up-conversion of CO_2-laser radiation image into near-IR or visible region, frequencies mixing in the middle IR region and differencial frequencies generation (DFG) in the middle IR region from 5.5 to 18.0μm]

GaN wire synthesis

Korea and Hanyang University researchers, working on gallium nitride (GaN), note that 1D nanostructures such as tubes and wires have attracted much attention because of their optical, electrical, mechanical, and magnetic properties, distinctive from those of the bulk materials. They have synthesised porous structured GaN nanowires with a large scale CVD of Ga/Ga2O3/B2O3/C mixture under NH3 flow. The average diameter is 40nm and length up to1mm. The porous GaN nanowires consist of the wurtzite single crystal grown with the [0 1 1] direction parallel to the wire axis. The pore size is 5–20nm. The porous GaN crystals are partially coated with nearly amorphous BCN layers. The photoluminescence exhibits a broad band in the energy range of 2.1–3.6eV.

Synthesis of Al nano arrays

Researchers at Nankai University and the Chinese Academy of Science produce ordered Al nanowire arrays with the same nanowire density but diameters decreased radially, embedded in one piece of anodic alumina membrane, successfully fabricated by a two-step synthesis: electrodeposition of Zn and replacement in AlCl3 solution. X-ray diffraction, SEM, TEM and selected-area EDT characterised the Al nano wires. SEM and TEM images taken from the different areas of the arrays show that the growth of aligned Al nanowires, with different diameters in a single process at the same time, can be controlled. The results have potential applications in photoelectric devices and opens up a new method for fabricating nano-scale materials. *Solid State Sciences* 5 (7) 1063-1067 (July 2003).

Nanostructured thermoelectric materials and devices

MIT is the applicant for US patent number 6,605772 for quantum-dot superlattice (QLSL) structures. These have improved thermoelectric properties. In one embodiment, PbSex Te1-x /PbTe QDSLs are provided having enhanced values of Seebeck coefficient and thermoelectric figure of merit (ZT) relative to bulk values. The structures can be combined into multi-chip devices to provide additional thermoelectric performance. As well as enhancement in the power factor, it is recognised that having a QDSL structure gives the enormous density of dissimilar materials interfaces (involving the wetting layer, the matrix layer, and dot layer of the QDSL structure) expected to lower the lattice thermal conductivity to values below those attainable by mere alloying.

Tests on the reduction of the thermal conductivity of superlattices have shown that the values were much lower than that of their constituents and even smaller than the thermal conductivity value of the equivalent compositional alloys. It is believed that phonon engineering with power-factor engineering may result in large improvements in the ZT of already good thermoelectric materials.

Single-ended converter

RF Micro Devices has an August patent, US 6606489, which involves converting differential signals to single-ended signals. This includes receiving a differential signal comprising a first current and a second current and applying the second current to a first load to generate a first voltage. A third current is generated in response to the first voltage. The first current is summed with the third current and applied to a second load to generate the single-ended signal.